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"**Measuring Affect, Behavior and Cognition for Modeling Disaster Risk Attitudes**"

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Abstract: We modelled disaster risk attitudes using top down and bottom up approaches. Top down, we constructed an attitudinal model to comprise of affect, behavior and cognition (ABC). Bottom-up, we mined ABC semantics from narratives of disaster experiences and gathered ABC data in online and field surveys. This report presents the findings of a pilot study that was conducted online to determine the suitability of the disaster attitudinal dashboard in measuring ABC, as well as to validate the ABC model. The tool contained four sections: Section A contained items on risk assessment using ranking and sorting of specific disaster images, Section B on ABC rating using a 7-point bipolar scale, Section C on situation awareness using videos of disasters, and Section D on trust and influence using disaster scenarios. These items measured people's attitudes toward flood (natural disaster) and fire (human induced disaster). To test for construct validity of the items, a survey among 32 young adults from Malaysia and Singapore was undertaken. MANOVA and Pearson correlation were used to analyze the results. The MANOVA results showed that the behavior of Malaysians towards flood differed significantly from Singaporeans, while the females differed significantly in affect/emotion from males in fire disaster situations. The inter-item correlations identified items that correlated significantly. The full tool is being developed to measure attitudes toward other natural disasters such as tsunami and earthquake, and human induced disasters such as transport accidents and terrorist attack. The survey will be conducted in four countries in Southeast Asia, namely: Indonesia, Malaysia, Philippines and Singapore.

Introduction

The Southeast Asian (SEA) region is vulnerable to many types of disasters, including floods, earthquakes, tsunamis, wildfire, mud slides and terrorist attacks. In SEA, many more people died as a result of natural disasters from 2001 to 2010 than during the previous decade, mainly because of two extreme events: the Indian Ocean earthquake and tsunami of 2004 and the Cyclone Nargis in Myanmar in 2008 [1].

While disasters can have many causes, the outcome is the same: chaos, panic, destruction and rescuers [2]. Natural disasters are traumatic events and they can affect individuals' risk attitudes in the short term and possibly the longer term.

We defined risk attitude as the chosen response of an individual or group to uncertainty, driven by perception. Understanding people's attitudes in disaster situations can help to prepare for better response strategies in mitigating disasters [3]. Our disaster attitudes can be quite different from our experiences, due to the interplay of our affective and cognitive systems [4]. Therefore, there is a need to understand how people think, feel and behave in disaster situations. Inspired by the tripartite model of attitude structure [5], later modeled as

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14. ABSTRACT

The researchers modeled disaster risk attitudes using top down and bottom up approaches. Top down, they constructed an attitudinal model to comprise of affect, behavior and cognition (ABC). Bottom-up, they mined ABC semantics from narratives of disaster experiences and gathered ABC data in online and field surveys. This report presents the findings of a pilot study that was conducted online to determine the suitability of the disaster attitudinal dashboard in measuring ABC, as well as to validate the ABC model.

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Affect, Behavior and Cognition by Breckler [6], we developed the attitudinal model as shown in Fig. 1.

In Fig. 1 Attitude is made up of three components: Affective, Behavior and Cognition (or ABC). *Affect* refers to human emotions or instincts such as anger, happiness, sadness; it also represents sensory experiences. *Behaviors* are overt, observable responses and actions. These are measurable, and therefore more easily identified than cognition or affect. *Cognition* encompasses human beliefs, values, decision-making, and perceptions of self, others, and the world. These include efficacy beliefs, perceptions of locus of control, and expectations [7].

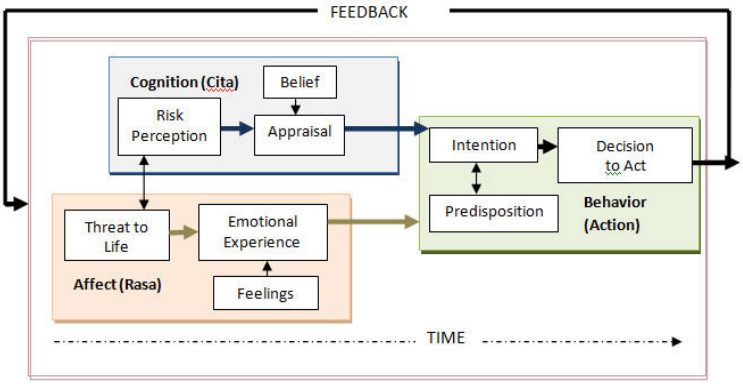

Figure 1. Affect, Behavior, Cognition (ABC) model [2]

In disaster situations, people perceive reality in at least two ways; one is affective (intuitive and experiential) and the other is cognitive (analytical and rational) [8] The affective system is fast. When a person responds to an event such as fire, there is an automatic search and event matching with the experiential system. However, formal decision making relies on the analytical and cognitive abilities; this mode is slow.

Affect in Fig. 1 is made up of threat to life, emotional experience influenced by feelings. Cognition comprised risk perception and situated cognition appraisal influenced by beliefs. Behavior is driven by intention and decision to execute affected by the disposition of the person at that moment in time. Depending on the type of disaster risk, the mapping between the components can differ. For example, fire can cause people to think and react fast due to the risk involved relative to flood. The ABC model for fire may be in the order of Cognition, Behavior, and Affect. For flood, it may be Affect first as people tend to care for themselves and others, then Cognition, followed by Behavior. These scenarios may be explored through the measurement of ABC.

Study Motivation and Approach

Aim. This study was aimed at measuring the ABC of people who may or may not have experienced disasters, and to validate the concepts in the attitudinal model.

Sample. The sample comprised 32 subjects from Malaysia, and Singapore with equal sample from each country. The sample was stratified into 16 males, aged between 21 and 28 (mean=25 years), and 16 females with ages ranging from 19 to 29 (mean=24 years). A majority of the subjects are university students and graduates.

Survey Instrument. The survey instrument is a web-based attitudinal dashboard that was developed in English using ABC concepts derived from a previous study. There were four sections in the tool: Section A contained items on risk assessment using ranking and sorting of specific disaster images, Section B on ABC rating using a 7-point bipolar scale, Section C on situation awareness using videos of disasters, and Section D on trust and influence using disaster scenarios. Fig. 2 shows the sorting measures for Task 1 on risk assessment of fire

images, and Fig. 3 on ABC ratings of flood on bipolar scale.

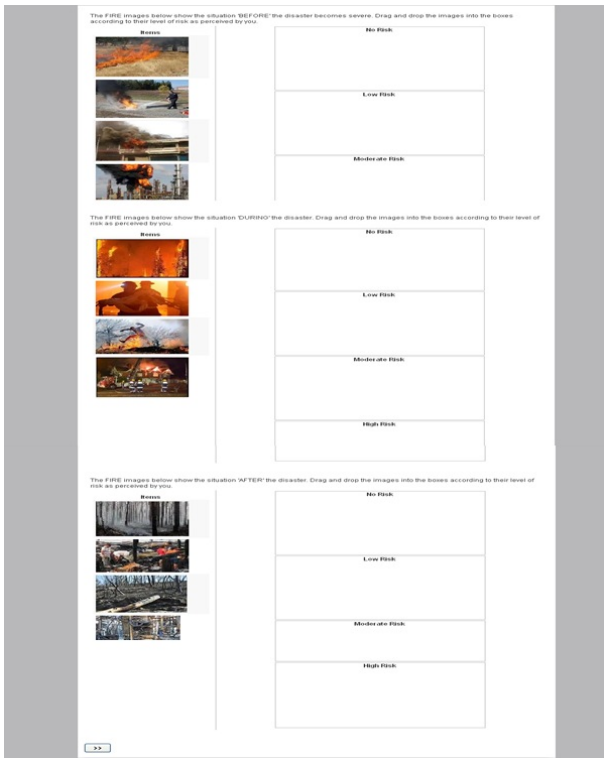

Figure 2. Sorting fire images into risk classes

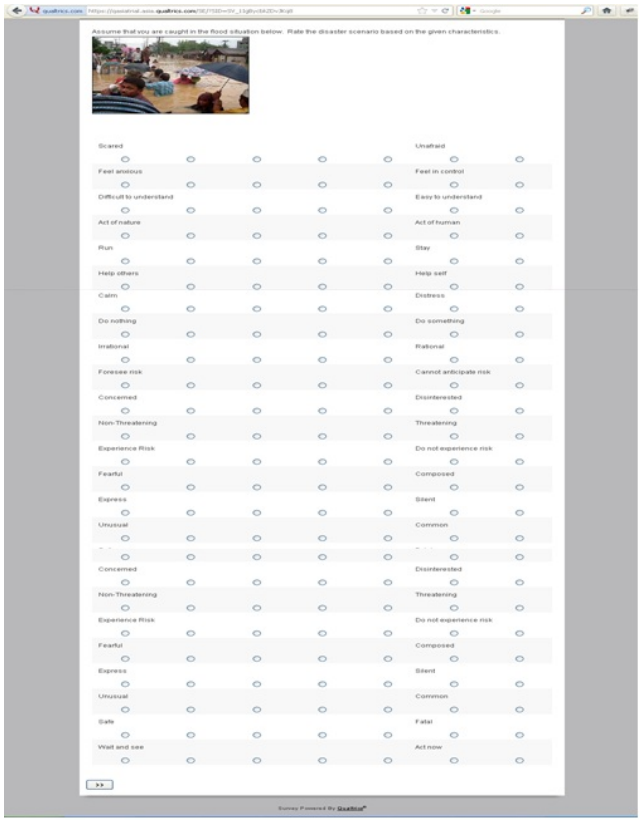

Figure 3. Rating ABC on 7-point bipolar scale

To construct the ABC scale, Table I shows the classification of items in accordance with the ABC components of the attitudinal model (see fig. 1). Each ABC sub-component has two measures on the bipolar sub-scale. For example, the sub-component for Affect is 'Threat to Life,' and it is measured on the items: 'Threatening–Non-threatening,' and 'Safe–Fatal.' The sub-component for Behavior is 'Intention' measured on items 'Do nothing–do something,' and 'Wait and see–Act now.' Likewise, the Cognition sub-component of 'Risk Perception' is measured on items 'Easy to understand–Difficult to understand' and 'Foresee risk–Cannot anticipate risk.' These items are measured on a 7-point scale and the order of items in the scale was randomized for each disaster type.

In addition, the items were also randomized in terms of their positive and negative order. For example, item 'Threatening-Non-threatening,' may appear in this order for Flood but the opposite order for Fire, 'Non-threatening-Threatening.' The randomization is to control for order effect and bias in test-taking attitude.

The items were scored from negative to positive, ranging from 1 (negative item) to a score of 7 (positive item).

TABLE I. MAPPING MEASURES TO ABC MODEL SUB-COMPONENTS

Attitudinal Attributes	AFFECT		
	Threat to life	Emotional experience	Feelings
Feel anxious-Feel in control		X	
Scared-Unafraid			X
Calm - Distress		X	
Fearful-Composed			X
Non-threatening – Threatening	X		
Safe-Fatal	X		
	BEHAVIOR		
	Intention	Decision to Act	Predisposition
Run-Stay		X	
Act of nature– Act of human			X
Help others – Help self		X	
Do nothing – Do something	X		
Experience risk – Do not experience risk			X
Wait and see –Act now	X		
	COGNITION		
	Belief	Risk Perception	Situated Cognition Appraisal
Easy to understand – Difficult to understand		X	
Express – Silent			X
Foresee risk– Cannot anticipate risk		X	
Irrational-Rational	X		
Concerned –Disinterested			X
Common-Unusual	X		

Procedure. Purposive sampling was used to recruit subjects on the basis of country, gender and age criteria. They completed the survey online for about half an hour. The survey introduced the objectives of the study and provided instructions on the task. After they consented to participate, subjects completed the section on participant profile. They then performed the ABC rating task and submitted their responses which were recorded in the database.

Data Analysis. The data were analyzed using SPSS v.15. Multivariate Analysis of Variance (MANOVA) was performed on the ABC data to test the effects of country and gender on ABC.

Results and Discussion

Table II provides a summary of one-way ANOVA on the effects of disaster type on ABC measures. Clearly, there were significant effects of disaster type on people's ABC.

TABLE II. EFFECTS OF DISASTER TYPE ON ABC

Factors	Measures	Sum of squares	df	Mean Square	F	p
Flood	Affect	293.72	19	15.46	2.95	0.03*
	Behavior	515.14	19	27.11	4.35	0.006*
	Cognitive	395.83	19	20.83	2.66	0.04*
Fire	Affect	356.35	18	19.80	3.82	0.009*
	Behavior	304.68	18	16.93	2.71	0.04*
	Cognitive	3866.91	18	214.83	27.39	0.001*

*significant at $p<0.05$

The results confirm that disasters do affect people at the level of their behavior, thinking or feeling, as revealed from the significant results (see Table II). Some people are nevertheless more vulnerable than others and suffer in different ways and to different extents [9]. The effect of flood on behavior was highly significant, $F(1,19)=4.35$, $p<0.01$. A sense of loss of control of one's destiny can lead to various indecisive actions such as whether to act or do nothing, to stay or to help others, and so forth.

In the case of fire, the impact was slightly greater on cognition, $F(1,18)=27.39$, $p<0.001$, and affect, $F(1,18)=3.82$, $p<0.01$ than behavior. People perceive higher risks with fire and cannot understand how it happened. Factors that can make people vulnerable include seeing family members trapped in the building; a scenario that can be fatal.

Table III and IV show the results of MANOVA for flood and fire, respectively.

TABLE III. EFFECTS OF GENDER AND NATIONALITY ON ABC TOWARD FLOOD

Factors	Measures	Sum of squares	df	Mean Square	F	p
Gender	Affect	16.72	1	16.72	1.37	0.25
	Behavior	8.59	1	8.59	0.71	0.41
	Cognitive	0.18	1	0.18	0.01	0.91
Nationality	Affect	3.06	1	0.31	0.25	0.62
	Behavior	119.17	1	119.17	9.82	0.00*
	Cognitive	0.69	1	0.69	0.05	0.82
Gender x Nationality	Affect	0.84	1	0.84	0.07	0.80
	Behavior	2.01	1	2.01	0.17	0.69
	Cognitive	1.00	1	1.00	0.08	0.78

*significant at $p<0.01$

From Table IV, it can be seen that the behavior of Malaysians toward flood differed significantly from Singaporeans, $F(1,32)=9.82$, $p<0.001$. This could be due to the fact Malaysians experience flood annually resulting in an immune neglect [10]. The reaction of a community to disaster is also influenced by its culture and institutions [11].

TABLE IV. EFFECTS OF GENDER AND NATIONALITY ON ABC TOWARDS FIRE

Factors	Measures	Sum of Squares	df	Mean Square	F	p
Gender	Affect	73.32	1	73.32	6.03	0.02*
	Behavior	15.17	1	15.74	1.14	0.30
	Cognitive	114.94	1	114.94	0.82	0.37
Nationality	Affect	32.11	1	32.11	2.64	0.12
	Behavior	1.78	1	1.78	0.13	0.72
	Cognitive	0.56	1	0.56	0.00	0.95
Gender x Nationality	Affect	16.00	1	16.00	1.32	0.26
	Behavior	2.25	1	2.25	0.17	0.68
	Cognitive	8.51	1	8.51	0.06	0.81

*significant $p<0.05$

There is an effect of gender on Affect, $F(1,32)=6.03$, $p<0.05$, suggesting that females may be more vulnerable than males in fire situation.

Conclusion

People's motivation to minimize the risk of injury, death and property damage in disasters can determine their ABC. The attitude a person develops towards a particular behavior in a disaster situation is also determined by positive or negative reinforcements they perceive from performing the behavior. Besides, the choices people make are influenced by their beliefs about how significant others will view their decisions during disaster.

The study has shown the importance of identifying ABC semantics across heterogeneous sources of disaster information for attitudinal modeling. The purpose is to forecast risk attitudes of people in different cultural settings so that a more comprehensive model of attitude may be developed for disaster management.

The pilot study has limitations due to the types of disasters being investigated and the small sample size comprising primarily of students. A larger field survey is being planned for four countries in Southeast Asia that are frequently affected by natural disasters.

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List of Publications:

Halimahtun M. Khalid, Martin G. Helander and Nilwan A. Hood (2012). Visualizing disaster attitudes resulting from terrorist activities, *International Journal of Applied Ergonomics*, DOI: 10.1016/j.apergo.2012.06.005.

Halimahtun M. Khalid and Siti Norazhani Ramli (2012). Measuring affect, behavior and cognition for modeling disaster risk attitudes*, IEEE Xplore*, http://ieeexplore.ieee.org/xpl/conferences.jsp.

Halimahtun M. Khalid (2011). Visualizing disaster attitudes from semantic mining of natural disasters narratives and experiences**.** In: M. Göbel (ed.) *Human Factors in Organizational Design and Management – X*, Grahamstown: IEA Press.

Halimahtun M. Khalid and Martin G. Helander (2011). Attitudinal modeling from semantic mining of disaster corpus, *Proceedings of HSCB Focus 2011*, 8-10 February 2011, Chantilly, VA.